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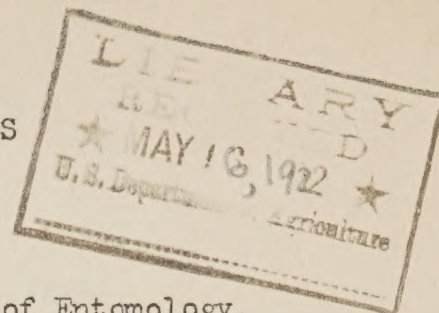
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SUGGESTIONS FOR THE HELP OF PHOTOGRAPHERS  
AT FIELD STATIONS  
OF THE  
DEPARTMENT OF AGRICULTURE



By J. G. Pratt, Scientific Photographer, Bureau of Entomology.

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SUGGESTIONS FOR THE HELP OF PHOTOGRAPHERS  
AT FIELD STATIONS  
OF THE  
DEPARTMENT OF AGRICULTURE.

By J. G. Pratt,  
Scientific Photographer,  
Bureau of Entomology.

In view of the great amount of photographic work being done at the entomological and other field stations of the Department of Agriculture it has been deemed wise to publish a paper, giving suggestions whereby agents may take advantage of the practical experience of experts at the Department. It is believed that considerable time and material should thus be saved in the elimination of experimental work in regard to formulas and other matters, as the efforts of research men along this line must necessarily be limited.

PHOTOGRAPHY IN THE FIELD.

Exposures.

In judging exposures the aim should be to secure a negative of good printing quality. This can be approximated by comparison with what the lens is known to be capable of doing in broad sunlight. Under the best conditions the lens at stop 8 should admit sufficient light in from one-fiftieth to one one-hundredth of a second, depending upon the season of the year. Late in the evening two or three times this amount could be given and on dark, cloudy days even ten times the normal exposure. Another thing to be taken into consideration is that each stop on the diaphragm admits just half as much light as the next larger stop. As the diaphragm is usually closed to some extent to give greater depth of focus, especially when objects near at hand are photographed, the method of judging the exposure would be about as follows:

MEMORANDUM FOR THE SECRETARY OF THE ARMY  
AT THE OFFICE OF THE SECRETARY  
OF THE ARMY  
WASHINGTON, D. C.

By J. O. Paine,  
Colonel, Ordnance Department,  
Department of the Army.

In view of the great amount of photographic work being done at the  
Ordnance Department and other field stations of the Department of the Army it  
has been deemed wise to publish a paper, giving suggestions whereby agents  
may take advantage of the practical experience of agents at the Department.  
It is believed that considerable time and material should thus be saved in  
the execution of photographic work in regard to technical and other matters  
as the efforts of agents will be more effectively directed.

TECHNIQUE IN THE FIELD

EXPOSURE

In making exposures the aim should be to secure a negative of good  
printing quality. This can be accomplished by comparison with what the film  
is known to be capable of doing in good weather. Under the best conditions  
the film is very sensitive and will give a good negative in one  
thirtieth of a second, depending upon the season of the year. Later in the  
season, two or three times this amount will be given and the result, cloudy and  
even less than the normal exposure. Another thing to be taken into consideration  
is that each step on the step wedge gives half as much light as the  
next larger step. As the exposure is usually altered to some extent to give  
greater depth of focus, especially when objects are at hand the photographic  
the method of making the exposure would be about as follows:

Supposing the light to be somewhat hazy, which about doubles the exposure required under normal conditions (making it about one-twenty-fifth of a second), that it is rather late in the evening (making the exposure one-twelfth of a second), and that stop 16 is being used (making the exposure one-sixth of a second), an exposure of one-fifth of a second would be given, as this is the nearest approach to one-sixth of a second on the automatic timing device. Photographic plates allow considerable latitude with regard to exposure, however, and if even double this amount of time were given a good printable negative could still be obtained. The exposure should not, however, be unduly long, as the negatives thus produced are so dense as to be of little value.

#### Photographing plants and small objects.

Plants and small objects can best be taken in the shade to avoid extreme highlights, although this is sometimes difficult with those in the field. Often, however, a large piece of paper or similar screen can be used to shield the object from the direct rays of the sun during the exposure. To prevent movement due to currents of air, it is sometimes good policy to stretch a wall of unbleached cotton or similar material on sticks all around the object, leaving just sufficient room for the operation of the camera.

#### Tilting top, swing-back, and rising front.

A tilting top is often necessary so that the camera can be pointed downward to photograph small growing plants. In such cases it would be well to study the uses of the swing-back, that is, if a view or other camera having this device is available. The idea is to equalize the distance between the flat surface of the photographic plate and the vertical, or other position,

Exposing the light to be removed, which must be done in the  
very rapid water current motion (making it about one-tenth of a  
second), and it is better late in the evening (making the exposure  
twice of a second), and when light is being used (making the exposure  
one-half of a second); an exposure of one-fifth of a second would be given  
as this is the nearest approach to one-tenth of a second on the automatic  
camera. Photographic plates allow considerable latitude with regard  
to exposure, however, and it even admits this amount of time with a  
good negative result could still be obtained. The exposure should not  
however be nearly long, as the negative thus produced are as likely as to be  
of little value.

Exposing objects and small objects.

Plates and small objects can best be taken in the studio to avoid ex-  
cess of light, although this is sometimes difficult with those in the field.  
Often, however, a large piece of paper or similar screen can be used to shield  
the object from the direct rays of the sun during the exposure. To prevent  
movement due to vibration of air, it is sometimes good policy to attach a well  
of exhausted cotton or similar material on which all around the object,  
leaving just sufficient room for the operation of the camera.

Exposing top, swing-back, and rising front.

A rising top is often necessary so that the camera can be pointed  
downward to photograph small growing plants. In such cases it would be well  
to study the uses of the swing-back, that is, if a view or other camera having  
this device is available. The idea is to equalize the distance between the  
flat surface of the photographic plate and the vertical, or other position,

of the object photographed in order to prevent distortion.

Supposing that the bottom of the plant is farthest from the plate, the camera back should be slanted or swung so that the top of the plate (the image being upside down) is brought closer to that portion of the plant; this will at the same time make the bottom of the plate (recording the top of the plant) farther from the top of the plant, thus tending to equalize the general photographic plane of the whole object.

In photographing a broad field view, the immediate foreground can also be brought into sharp focus by proper use of the swing-back.

In photographing tall objects, such as trees, the rising front should be utilized in order to avoid pointing the camera upward, which also causes distortion.

#### PHOTOGRAPHING SMALL OBJECTS IN THE LABORATORY.

Of course, a well lighted studio is much to be desired but this is not usually to be had at field stations. Photographs can be taken near a large window, with the use of a white blotter or other reflector to light up the dark side of the object. If much photographic work is to be done, however, it would be far preferable to glass in one end of the laboratory porch, or to construct a 6-foot or 8-foot ground-glass skylight in the room to be used for this purpose. Light coming from the north is best for ordinary work, such as leaves, fruit, etc., but for minute specimens, where direct photographs are to be taken at more or less magnification, the direct rays of the sun can be used to better advantage, shaded possibly by ground-glass or tracing cloth.

#### Laboratory stand.

A tilting top can be used in order to point the camera downward toward a table or vertically, with the specimen directly underneath, but difficulty



will be experienced in adjusting the length of the tripod in order to secure the desired distance between the camera and the object to be photographed. A laboratory stand is therefore practically indispensable, and if a commercial outfit can not be secured, one can probably be constructed from odds and ends around the laboratory.

#### The camera for the laboratory.

By far the best camera for the laboratory is one of the "view" type, with a long bellows and racking at both ends, which enables the lens to be brought into accurate focus at any distance from the object photographed.

#### Lenses.

Fair work in the field can be secured with a good lens of the rapid rectilinear type, especially by stopping down and thus increasing the covering qualities, but for work in the laboratory, where photographs will be taken up to natural size and possibly at more or less magnification, an anastigmat lens is indispensable in order that the proper definition for reproduction may be secured.

#### Backgrounds.

White backgrounds.--The question of backgrounds enters very largely into the photography of small objects in the laboratory. White grounds are the easiest and therefore the most generally used. These are obtained with the camera in a vertical position by placing the specimen on a piece of ground-glass, with a white reflector several inches underneath, and preferably slanted to catch the light to the best advantage. It might be stated here that a reflector should also be placed so as to light up the dark side of the object. A good plan is to construct a box, about 10 inches square and 6 inches deep, open at the top and front and lined with white paper. This makes an easy .



support for the ground-glass.

Gray backgrounds.--When gray grounds are desired, clear glass can be substituted for the ground-glass, with a gray card underneath. If necessary this can be moved slightly during the exposure to prevent mottling. This method prevents the object from throwing a shadow, which is often undesirable in scientific work. If reflections across the plate are encountered they can be obviated by using a thin tissue-paper or tracing-cloth hood, in the shape of a cornucopia, extending from the lens down to the glass support, although of course this lengthens the exposure to some extent.

Another excellent method of securing clean gray backgrounds is by using an invisible support for holding the object. Solder about a 9-inch section of 1/4-inch brass pipe vertically to a flat metal support, and if desirable a T-joint can be made to fit in the up end. With the aid of a little modeling clay this will easily support almost any small object which it is desired to photograph. A 10-cent store curtain rod and a 4-inch square of tin will answer admirably for this purpose. The pipe support, of course, is run up through a gray cardboard, an 8 by 10 gray photographic mount being especially adaptable for this purpose. Two of these supports can be employed, if necessary, for a long and heavy object, such as an ear of corn.

Still another method of securing gray grounds, which is very dependable but allows the object to throw a shadow, consists in placing the specimen on a piece of very fine (mud-ground) ground-glass, backed on the underside with a piece of black paper.

Black backgrounds.--Black backgrounds can be secured by placing the object on a clean piece of black velvet, or by using what is known as the "dark box." The latter is merely a box of considerable depth, lined inside with



black paint or paper, and with an aperture in the top sufficiently large to accommodate the specimen, which is placed on a clear glass over this black hole

Clean backgrounds can not be obtained satisfactorily by placing the specimen on gray or black cardboard, as the tiny corrugations in the board show in the photograph.

#### Color screens.

Most of the work in the field can be recorded accurately on orthonon plates or films without a color screen. Vegetation of various kinds, however, can sometimes be photographed with better color rendering by using a light yellow screen, such as that known as the K-1; being sure, however, to know the factor of the screen and give ample exposure. The screen renders lighter the greens and yellows in the monotone reproduction but should not be used where the prolonged exposure will tend to show movement in the object photographed.

In laboratory work the color screen is used to a much greater extent than in the field, and if the object contains deep yellow, orange, or red, a panchromatic plate must be resorted to in conjunction with the color screen, if proper rendering is to be secured. For deep yellow, use the K-2, and the K-3 where reds predominate. These two screens with panchromatic plates require respectively only three and four times the normal exposure, although with orthonon plates the exposure is so prolonged as to be impractical.

#### Direct photographs at more or less magnification.

It is sometimes desirable to take direct photographs at more or less magnification, in handling minute specimens, such as insects, galls, fungi, leaves, etc., and it is desirable for this purpose to have a rather short focus lens and a camera with a long bellows extension. For natural size the bellows extension must be twice the focal length of the lens, and where the object is to be magnified, the bellows must be drawn back still farther. In such cases



the exposure will be the square of the distance between the lens and the plate, multiplied by the correct exposure for natural size. As an illustration A 6-inch lens must have a bellows extension of 12 inches or one foot to produce a photograph of natural size, or 1 diameter. If the exposure for this is 10 seconds and the object is to be magnified to 4 diameters, it will be necessary to extend the bellows back to, we will say, 2 feet. The exposure at 4 diameters will be, therefore,  $2^2 \times 10$ , or 40 seconds.

In magnification work the background methods previously described will apply, except that where clear glass is used for gray grounds extreme care must be taken to eliminate all dust as this will be magnified and appear in-unsightly white spots in the photographs. In the "invisible support" method the metal support must be small enough so as to be completely hidden by the specimen, and it need be only 4 or 5 inches high, as at magnification the lens has much less depth of focus.

When objects are magnified the depth of focus is shortened in about the same proportion that the length of exposure is increased, and it will therefore be seen that the diaphragm should be stopped down as much as practical exposure will permit in order to secure the greatest possible definition.

The bellows extension of the 5 by 7 view camera can be extended as much as desired by inserting a dark section between the end of the bellows and the plate back, and the larger cameras with big front boards can be extended materially by using a long cone, one end to take the lens and the other to fit snugly in the lens board opening. The use of a cone in magnification work is especially desirable as otherwise too much light is cut off from the specimen by the square front of the camera.

It is advisable to use the longest focus lens which the bellows extension



will permit for any given magnification. The writer uses a 7-inch lens for magnifications up to 7 diameters, and a 72-mm., or nearly 3-inch lens, from 8 to 20 diameters. The longer the focus, the farther the lens is from the object; consequently the better the perspective and the greater the depth of focus.

#### Panchromatic plates.

Unlike orthochromon plates and films, which can be developed under the ordinary ruby light, the panchromatic plate must be developed in total darkness, or with the aid of the so-called "safe-light," which gives but a weak, green glow, of only sufficient luminosity to enable the photographer to distinguish the location of the trays or tanks. The best way to develop panchromatic plates is by the time and temperature system, that is, using a solution which takes, say, 6 minutes for complete development, at a given temperature, usually between 65° and 68° F.

Place the plate in the tray or tank and cover same to prevent the possibility of light reaching it during the time of development. If a tray is used it should be rocked gently for about two minutes to insure even development. At the end of the 6 minutes, rinse in clean water and place immediately in the hypo; in three or four minutes it can be examined, and if over or under exposed, it can be retaken. If the plate is very dense, try again at half the exposure, and so on.

It is not always possible to judge from the negative as to whether the lighting, background, and color screen were all the most appropriate for the object photographed, but this can be determined upon making the print.

#### Tray development.

If photographic work is done only occasionally, the tray method of developing negatives is preferable in order to obviate the deterioration of a



large amount of chemicals, and the following formula is recommended as giving excellent results:

Water.....	ounces..	120
Methol.....	grains..	56
Sulphite .....	ounces..	2-1/2
Hydroquinone.....	grains..	240
Carbonate.....	ounces..	3-1/2
Bromide.....	grains..	48

This at a temperature of 58° F. takes approximately 6 minutes for the complete development of a well timed negative, though if the tray is rocked continuously, 4 minutes will probably answer. The developer should be mixed in hot water (about 125° F.) and the chemicals should be completely dissolved in the order named. When allowed to cool it is ready for use and can be kept in a bottle, about 12 ounces, or whatever is necessary for the batch of plates in hand, being poured out into the tray; and if not overused, this can be poured back into the bottle and used repeatedly for at least two months without noticeable deterioration.

#### Tank Development.

Several companies furnish small metal tanks with racks holding a dozen plates, and covers so that after loading the light can be turned on during the 15 or 20 minutes development. This method is especially adaptable where many negatives accumulate at wide intervals, such as after trips into the field. The pyro developer recommended comes in papers with ample directions for time, temperature, etc., and it should be stated that the tank method takes care of overexposed and underexposed negatives to the best possible advantage, and with much less labor than when each plate is developed separately in a tray.

Where a laboratory is in constant use, however, the larger tanks, holding from 1 to 3 gallons of solution and employing hangers for the plates and films, are to be recommended. Once the tank is filled with the proper solution



it can be used continuously for many months and all that is necessary is to have a supply of the same solution ready at all times to keep the tank filled up to the proper level as it is used out or evaporates. Three tanks of the same size should be used in a row, to contain the developer, wash or rinse water and hypo. A tank of acid hypo should keep for two months or more, and the plate should remain in this solution for about 15 minutes and then be washed in running water for from 15 to 30 minutes. The developing tank should have a floating top, to prevent oxidization.

The 6-minute formula given above for tray development has been used by the writer for tanks, day in and day out, for as long as eight months, with apparently no decrease in the brilliancy of the negative and with no increase in the time of development.

Hypo bath for hot climate development.

Considerable trouble is encountered at the southern stations, or elsewhere, during the hot months because the wash water is so warm as to soften the film. This can be practically obviated by use of the following hypo bath:

Mix, in order given

No. 1.	Water.....	ounces..	100
	Sulphuric acid .....	drams ..	3
	Sulphite soda .....	ounces..	4

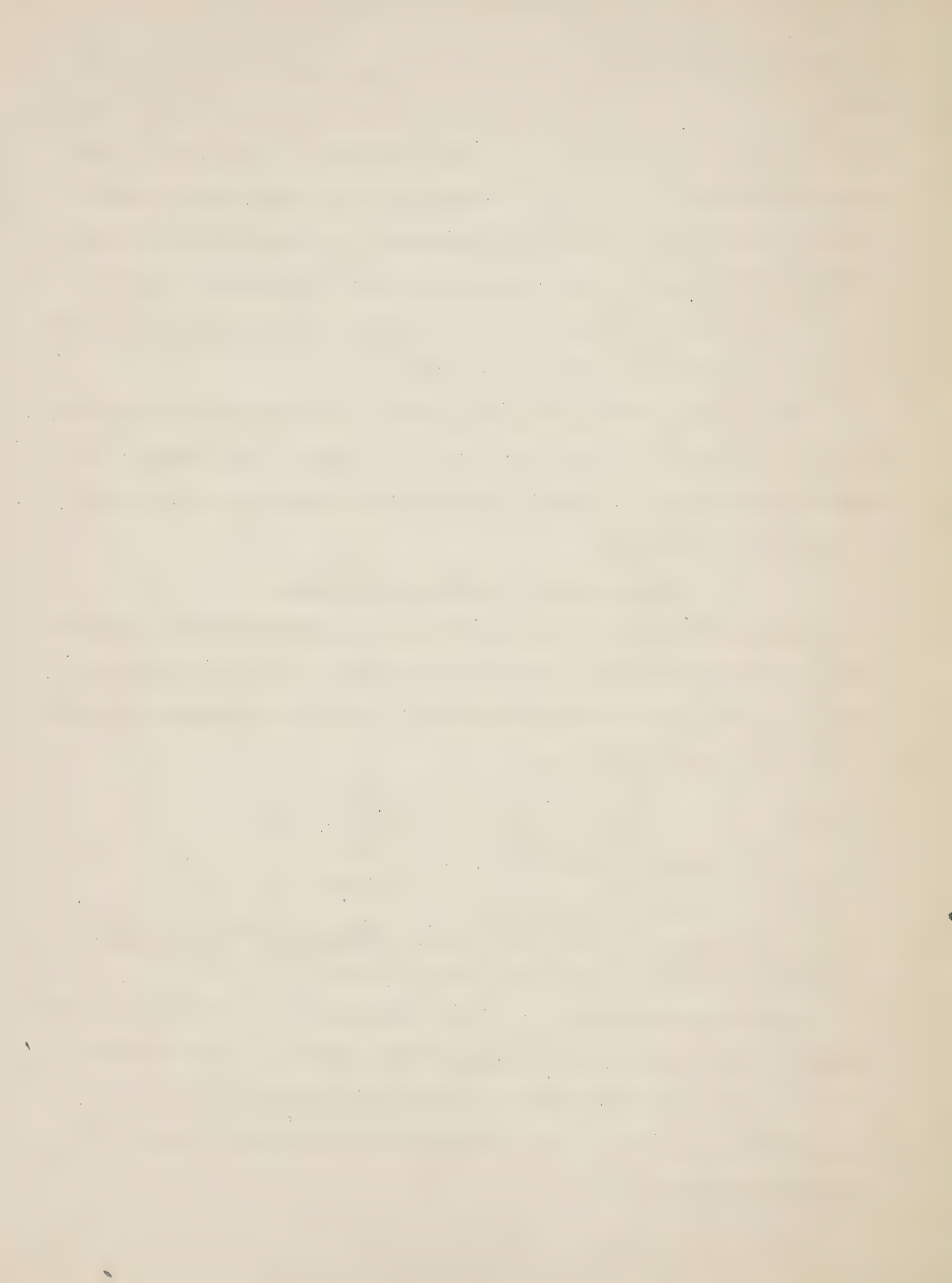
When dissolved add

Hypo .....	pounds..	2
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Dissolve and then add

Chrome alum from 1 to 2 ounces previously dissolved in 20 ounces of water. Then add water to make 160 ounces. The quantity of chrome alum may be increased during extremely hot weather.

Negatives should remain in the bath fully 15 minutes and they will then require from 10 to 15 minutes washing in running water. If washed vertically in a tank, the water should come in at the bottom and flow off at the top. It is safest also to have a small opening at the bottom where the hypo which settles can drain off.



Another excellent method to harden the films in hot weather, especially where tray developer is used, is to place the negative for 3 minutes in the following solution, after development and without rinsing:

Chrome alum.....	ounces ..	6-1/3
Sulphuric acid.....	drams ...	2
Water.....	gallon ..	1

Then, without rinsing, place the negative in the acid hypo (formula No. 2). This so hardens the gelatin that washing in warm water has little or no injurious effect.

In cool weather the following formula is most generally used for the acid fixing bath:

No. 2	Water .....	gallons ..	1-1/2
	Hypo .....	pounds ...	3
	Sulphite .....	ounces ...	3
	Acetic acid, 28 per cent ..	ounces ...	9
	Powdered alum .....	ounces ...	3

Dissolving the hypo can be greatly facilitated by placing it in a cotton bunting bag, suspending the same near the top of the receptacle. After washing, the negative should be gently swabbed under the tap with a tuft of cotton and then placed in the rack to dry.

#### PRINTING PROCESSES.

If the laboratory is equipped with a printing machine, especially the 8 by 10 size or larger, its use is by far preferable to that of printing frames, as "stunts" in shading and doctoring up the negative can be performed, never dreamed of in the other method. The writer's original ideas on this subject are given in some detail in AMERICAN PHOTOGRAPHY for July, 1921, but a few suggestions will be given here which may be of assistance.

Small pieces of tissue paper of one or more thicknesses can be placed on the opal or ground glass, which is one-half inch or so under the negative, to hold back any portions which are too thin in comparison with the rest of the plate. Likewise a large piece of tissue with appropriate-size holes cut



in it can be used to print deeper any unusually dense portions of the negative. If this does not answer for certain areas which are unusually dense, a hole the size of the portion to be brought out can be cut in a large piece of opaque paper, and a narrow paper handle attached thereto with paste or binding tape. This can be slipped under the plate glass so that the hole registers with the portion to be overprinted. When this has been printed sufficiently long, the lever can be released and, without moving the sensitive paper, the plate glass can be lifted up sufficiently to draw off the mask. The lever should then be brought down again and the whole negative printed long enough to bring out the thinner portions. This seems rather complicated but it soon becomes second nature to judge the exposure for both thin and dense portions, and the distance between the mask and the negative so diffuses the vignetted portion that the result of the double printing is not discernible.

#### Photographic papers.

There are several good photographic papers on the market and they all have their uses but it is not the policy of the Department to recommend any commercial products. Information will be furnished upon request, however, as to those best adapted to the needs of the work in question. Three grades of paper should always be available, viz., contrast, medium, and soft. Contrast paper should be used for thin, flat negatives, usually caused by underexposure or underdevelopment; medium, where the negative is of good quality, with the highlights and shadows evenly balanced; and soft paper should be used for dense or extremely contrasty negatives, caused by overexposure, overdevelopment, or development in too warm a solution. Glossy paper is most suitable for half-tone reproduction.



The following has been found to be a good all-around developer for most grades of paper:

Water .....	gallon ..	1
Methol .....	grains ..	180
Sulphite .....	ounces ..	6
Hydroquinone .....	ounces ..	1-1/2
Carbonate .....	ounces ..	9
Bromide .....	grains ..	66
Wood alcohol (to prevent the chemicals from precipitat- ing).....	ounces ..	4 to 5

For use, take 1 part stock solution to 2 parts water. The stock solution will keep indefinitely in a well corked bottle.

The exposure in the machine or printing frame should be so timed that the image will take about 30 seconds for complete development. It should then be well rinsed in water and placed immediately in the acid hypo (formula 2), care being taken that the print is completely submerged. It should remain in the hypo for approximately 20 minutes and then washed for about one hour in running water, which should be stirred occasionally to insure complete washing.

Unless a machine is available, prints can be best dried by placing them face down on a stretcher of cotton bunting.

The developer and hypo should be used at a temperature of approximately 70° F. and if glossy paper is used, a pinch of potassium iodide should be added to the tray solution to prevent abrasion. If abrasion marks still appear on the dried prints, they can be removed by rubbing gently with a tuft of cotton moistened with wood alcohol.

#### Copying.

In copying photographs, the orthonon plate or film should be used with the regular developer. In cases where it is desired to copy a line drawing or



a black-and-white page of printed matter, however, the process plate or film should be used, and should be developed in the following solution in order to give sufficient contrast:

No. 1	Potassium metabisulphite or		
	sodium bisulphite.....	ounce .. 3/4, grains ..	32
	Hydroquinone.....	ounce .. 3/4, grains ..	32
	Potassium bromide .....	ounce .. 3/4, grains ..	32
	Water .....	ounces .	32
No. 2	Caustic soda .....	ounces ..	1-1/2
	Water.....	ounces ..	32

Use equal parts of Nos. 1 and 2, and development should be complete in about 3 minutes at 65° or 70° F.

Any of the firms making camera equipment or photographic materials will be glad to furnish free of charge numerous booklets giving more complete data relative to negative making and the use of photographic papers, and the following are some which might be of especial use in this connection:

Hammer Dry Plate Co., New York City,	"Negative Making."
Cramer Dry Plate Co., St. Louis, Mo.	"Manual on Negative Making and Formulas."
Eastman Kodak Co., Rochester, N. Y.	"Elementary Photographic Chemistry." "About Lenses" "Color Plates and Filters."

If a knowledge of enlarging or lantern slide making is desired, booklets on these subjects can be had from the Eastman Kodak Co., for the asking.





